Choosing a path

It is right, right?

Abstract

This research was made to study the behavior of players when choosing a path in games.

We created a level with very simple rooms of various shapes. The rooms were modelled in 3D Studio Max and then imported to Unreal Engine 4.6. These rooms had either 2 or 3 doors that the player had to choose from. The players walked through 7 different rooms of this kind and the choice of directions they made were registered. The level was tested at 50 people and the data gathered was then studied in the search for patterns.

The result showed that forward was the dominating path that the players chose.

The results could be affected by the order of the rooms, the shape of the room or where in the room the player entered from. Some of the players walked in circles.

The result of the data gathered shows that many people follows the general value principle, meaning that people often chose the most economical path, the path that makes them change course as little as possible.

Contents

Background

When designing rooms, dungeons or even whole world maps in a game there is often multiple paths for the player to choose from. In that moment the player might have some clues about where to head next, but if they don't what will the player do? The goal for this research were to find an answer to the following question.

When choosing a path with no obvious directions is there a pattern which humans usually follow? For example: do they usually go to the right?

There have been multiple research regarding the movement pattern of people when choosing their own paths before.

In *An Analysis of Visitor Circulation: Movement Patterns and the General Value Principle*[1] by Stephen Bitgood, Stephen summarize studies that has been made on the movement pattern of people when visiting museums. He mentions the general value principle and explains it like this:

"*The general value principle (Bitgood 2005; 2006) argues that the value of an experience is calculated (usually unconsciously) as a ratio between the benefits and the costs. We attend to things that are perceived as beneficial (such as satisfying curiosity, enjoyment) only if the costs are perceived as low in relation to the benefits. This means the value of an experience may change even if the perceived benefits stay the same. That is, if the costs (time, effort, and so on) are perceived to be high, the value of the experience is lower than it would be if the costs were perceived to be low.*"

In our study the players only had two or three identical doors to choose from, so this principle was used when looking for patterns in choosing a path regarding cost and not benefit.

Walking Straight into Circles (Jan L. Souman, Ilja Frissen, Manish N. Sreenivasa and Marc O. Ernst, 2009)[1] is a study about how people navigate in unfamiliar areas. They found that on a cloudy day in a forest the test subjects moved around in circles whereas the test subjects that walked in the forest on a sunny day could navigate almost straight.

This result combined with having the test subjects try to walk in a straight line while blindfolded led to the conclusion that without a landmark (e.g. the sun) the subjects walked in paths similar to when blindfolded; in circles.

Hypothesis

Our hypothesis for this research was that the players would choose a direction and then continue to follow that direction throughout the rooms.

Method

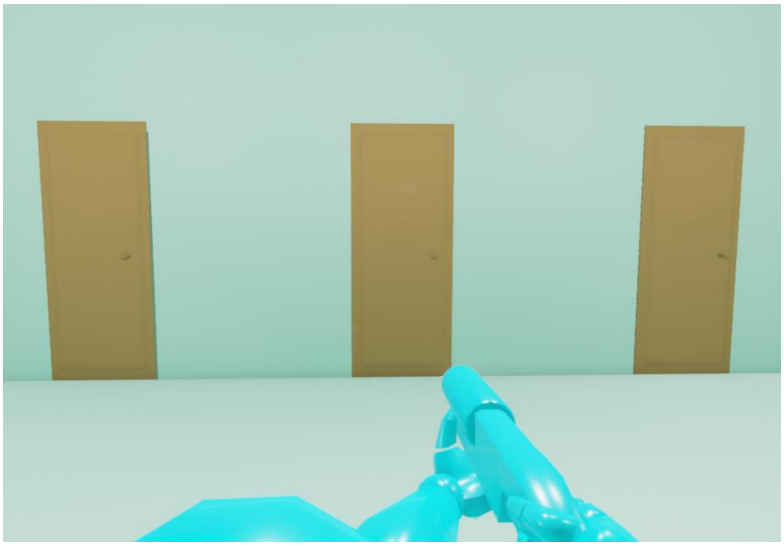
To test our hypothesis we created seven digital rooms different in shape or height. We then create a simple game where the player is to walk up to a door press a button to select it and is then teleported to the next room. The next room and the position and rotation of the player is always the same regardless of the door chosen in the previous room.
The rooms are as follow:

- Two rectangular rooms with three doors placed on the same wall[1a]
- Two octagonal rooms with three doors placed on separate walls[1b]
- Two square rooms with two doors placed on opposite walls[1c]
- One rectangular room with three doors placed on separate walls[1d]

The rooms of which there are two of are different from each other; one have a higher ceiling.

The test was developed in Unreal Engine 4.6 using the included example of a first-person shooter character with model, animation and functionality for movement implemented.

Since we used Unreal Engine's standard first-person character, the rooms were designed to match the measurements of this character. The character is 2 meters tall but can jump to a height of around 2,5 meters. Because of this the doors were modelled to be 2,7 meter in height. The width of the door was 1,1 meter. This measurement was decided mainly to make the door look realistic together with the doors height. The door also got some smaller details like a door knob, just to make sure it looked like a door for the players.



The doors in-game.

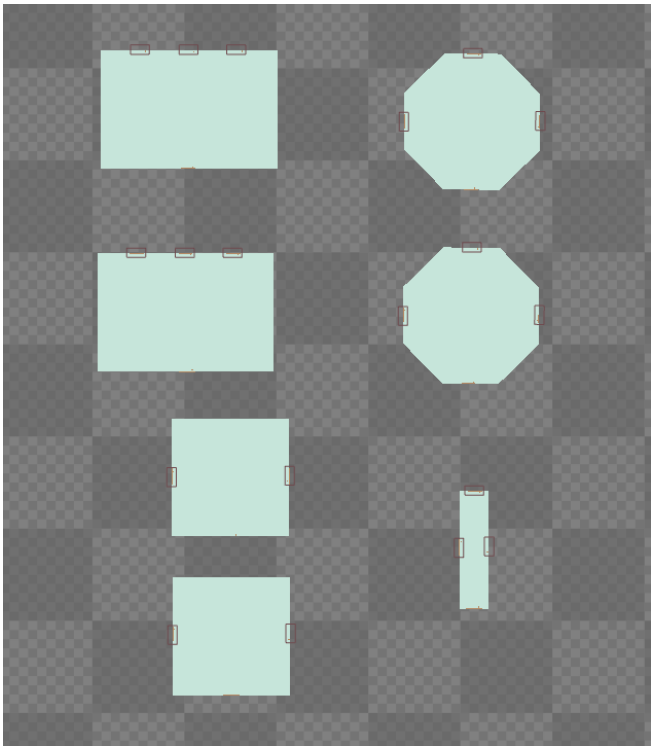
We created seven different rooms that the player should walk through. As mentioned earlier, three of these rooms had doubles where the only difference were a higher ceiling. This was because we wanted to see if the player would make the same decision in similar looking rooms.

The measurements of the seven rooms that were made were:

- Rectangular room 1 - Sides: 8 x 12 meter, Height: 3 meters.
- Rectangular room 2 - Sides: 8 x 12 meter, Height: 8 meters.
- Square room 1 - Sides: 8 x 8 meter, Height: 3 meter
- Square room 2 - Sides: 8 x 8 meter, Height: 8 meter
- Octogonal room 1 - Radius: 5 meter, Height: 3 meter
- Octogonal room 1 - Radius: 5 meter, Height: 8 meter
- Rectangular room 3 - Sides: 8 x 2 meter, Height: 3 meter

The rooms were modelled in 3D Studio Max 2014. We choose to make them as simple as possible since we only wanted the players to notice and think about the doors.

The doors were then placed in the rooms as shown on the following picture. Once the rooms and doors were finished they were exported from 3D Studio Max. They were then imported into Unreal Engine.



The rooms and the location of the doors.

After the models had been imported to Unreal Engine the game needed some programming in order to allow the player to select a door and be teleported to the next room. This was done entirely in Unreal Engine's own system called Blueprints. Blueprints are a node based system that allows the user to create functionality through graphical nodes that represent c++ functions and variables defined in the source code of Unreal Engine.

For this test the smallest amount of functionality was implemented. The game displays text telling the player what to do at the start of the game and what button to press to "open" a door when in range to do so.

As mentioned it also presents the functionality to choose a door and teleport the player to the next room upon doing so. The functionality for this is put into the doors blueprints which can be seen in figure 2a and b.

Functionality that would have removed some margin of error was to have the game output what doors were chosen into a .txt file. This would have given us definitive data instead of us recording the choices of the players manually which leaves room for error. This feature unfortunately had to be cut as it did not hinder our ability to perform the tests and there simply was not enough time to implement it.

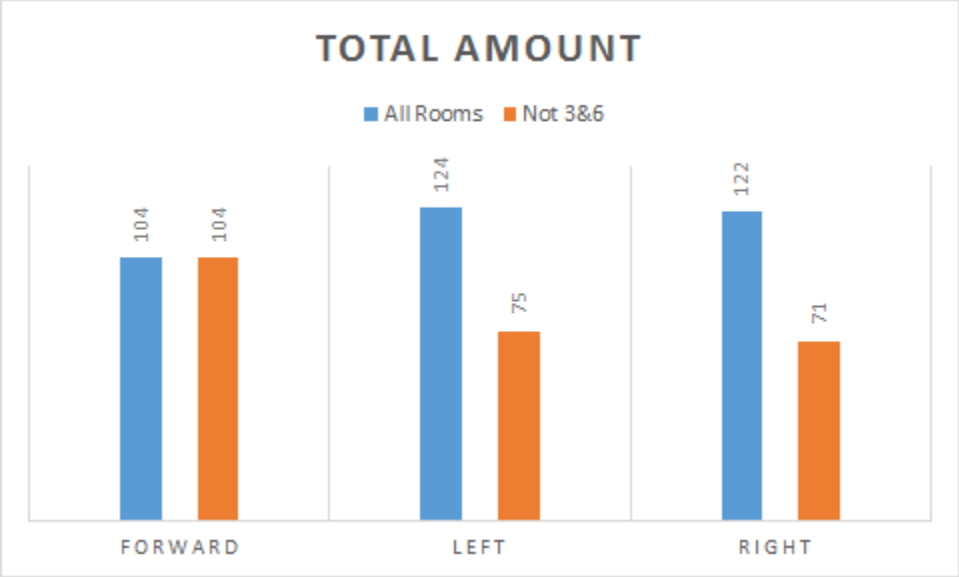
Once the level was done we brought the level with us and play tested it on people. We asked people to walk through the level and open doors. We did not tell them what we were testing until they had finished. We studied the players while they were walking through the level and took notes of which door they chose in what room. This data was then analyzed when we returned home.

The participants were not limited to a specific age group since we only made the study based on people's choice of direction, something that is possible to study in all age groups.

Results

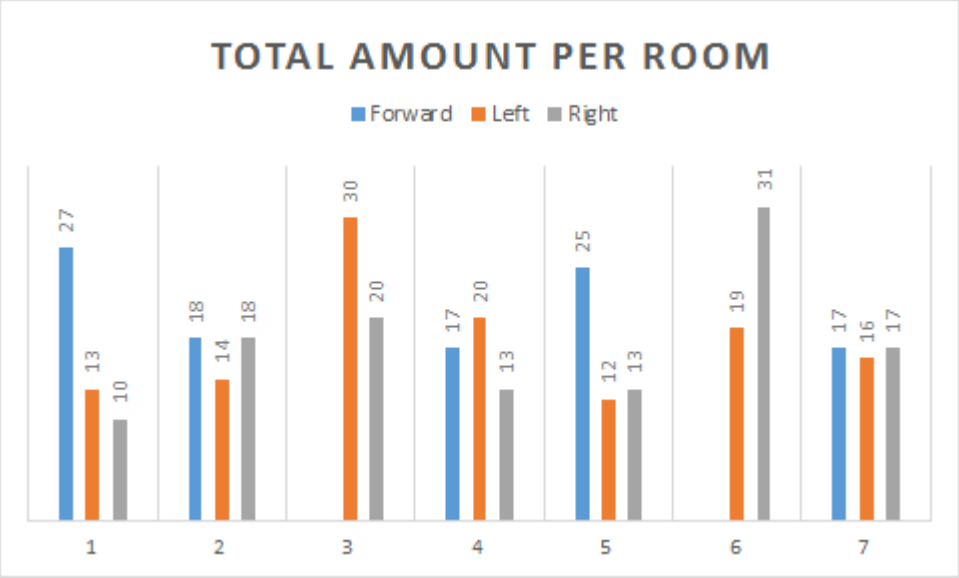
The level was play tested at 50 people and the data we gathered was then studied and searched for patterns. The data gave us some interesting result that we present below.

This graph shows the total amount of forward, left and right doors that were chosen. The orange bar shows the amount when not counting the rooms with just two doors (meaning they only have left and right as options).



Graph 1

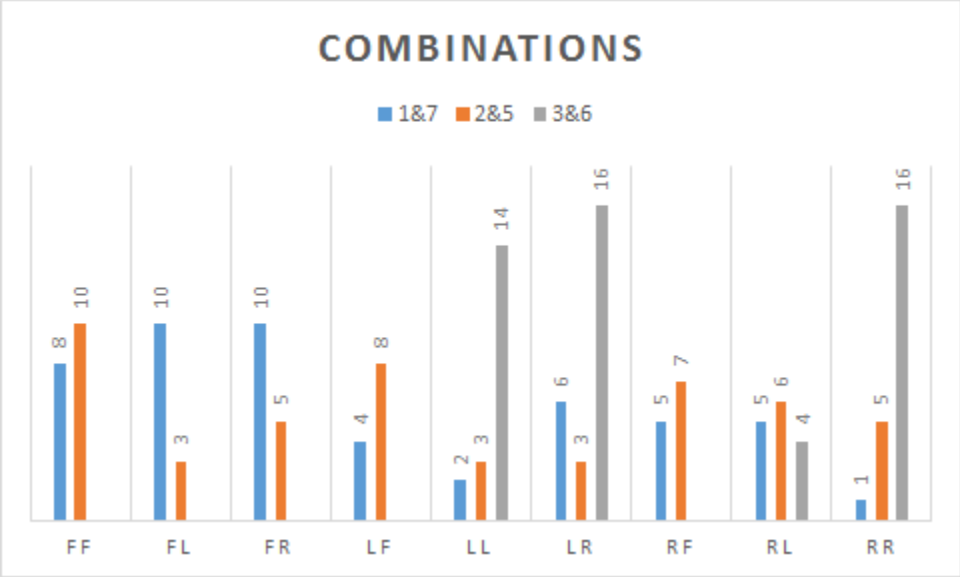
Here follows the graph of which direction that was most popular in each room.



Graph 2

Room 1 & 7 are rectangular with 3 doors, all doors on the same wall.
Room 2 & 5 are octagonal with 3 doors, each door on separate walls.
Room 3 & 6 are square with 2 doors, each door on separate walls.
Room 4 is rectangular with three doors, each door on separate walls.

Following is a graph showing the combination of door chosen in the room shapes that the player encountered twice. F stands for forward, L for left and R for right. The combination is written as AB where A is the door chosen first time the room was encountered and B being the door chosen the second time the room was encountered.



Graph 3

Of the testers, only 5 took different directions in each room. (Never the same direction twice in a row).

Also of our 50 testers, 22 of them took the same way at least 4 times (did not have to be in a row) and 16 of our testers took the same way throughout 3 rooms in a row. Only 7 out of the participants chose the same direction at least 5 times and 0 chose the same direction 6 times.

10 of the participants walked in complete circles. A complete circle in this case is defined as 3 doors in one direction after counting the total against the amount of doors in the opposite direction, e.g. if a player walked 4 times to the left and 2 times to the right it would be calculated as 4-2 = 2 resulting in the player not walking in a complete circle. Forward was not counted at all in this calculation.

Raw test results can be found in the appendix.

Discussion

The results show that the players more often than not choose a door leading forward. In graph 1 we can see that if we do not count the rooms without an option to choose a door forward the option to take the path leading forward is greatly favored.

Looking at graph 3 we can see that the combinations including a forward path is favored here as well. This would further strengthen the vision that the players would choose a path leading forward when possible, regardless of the shape of the room.

This also strengthen the idea of the general value principle. Walking forward in these room would be the most economical way since the players does not have to turn around or change their mindset in anyway.

In *An Analysis of Visitor Circulation: Movement Patterns and the General Value Principle* by Stephen Bitgood, Stephen also talks about the choice of direction in choice points.

"*When people come to an intersection with the traditional four-path, perpendicular arrangement, they are generally on the right side of the path. The most economical choice is to turn right (...)On the other hand, if one approaches the intersection on the left-hand side of the path, it would be more economical to turn left(...).Since people tend to walk on the right, most visitors are on the right when they come to a choice point and consequently turn right.*"

Since the players always entered the different rooms from a door placed on the center of the wall opposite to the door leading forward there is a connection between forward being the most economical way to go and the results of the test.

The majority of people walking forward might be a consequence of the position in which the player enters the room. It would be interesting to remake this test with another placement of the rooms entrance, e.g. if the player entered the room slightly to the right would the result be that right was the favored direction?

If we look closer at graph 3 we can see that the rectangular room with three doors on the same wall (1&7) have the highest amount of combinations where the player first choose forward while the octagonal room with three doors on separate walls(2&5) have a more diverse set of combinations among the top scoring ones. Forward at first encounter is still the favored one but second and third in place are left and right at first encounter and if we look at graph 2 we can see that room 1 have a much more forward dominated result than room 2.

This could be a result of the order of the rooms, when the players are first put in front of a door they take the first one possible just to see what happens when opening a door. After finding out the rules of the game they start exploring and play around with the game, therefore more often choosing the doors on the sides of the room.

The results could also be affected by the different shapes of the rooms but if we look at graph 2 it shows us that room 5 and 7 (which are the duplicates of 1 and 2) have the reversed results of room 1 and 2. This would imply that the results are dependent of the order of the rooms rather than the shapes of the rooms.

The last room (room 7) is the same shape as the first room (room 1), only with lower ceiling. If we compare the choice of direction in graph 2, it is very clear that the result of room one is heavily influenced by it being the first room encountered when entering the game. Once the player reaches the last room the result is much more evenly spread out in choice of direction and has the most even score.

The test in *Walking straight into Circles* is not identical to ours since the test evaluated the human ability to navigate without any landmarks and our test have very defined landmarks in the shape of definitive directions. This allows the player to easily navigate if it wishes to however not everyone seems to do.

As mentioned 22 of the participants chose the same direction at least 4 times. Choosing to go right 4 times out of 7 means that the player will walk in a circular path unless the 3 other choices are all left.

10 of our participants walked in complete circles showing that players do not navigate by directions automatically and end up with the same results as if blindfolded. This could however also be an effect of participants wanting to keep on direction throughout the test but only 7 took the same path 5 times and 0 took the same direction 6 times. So there were no participant that tried to explicitly only walk along one path.

Unfortunately this result is too vague to declare any conclusions upon but with further testing this could prove to be an important part of information regarding how players navigate and decipher a digital world.

Conclusion

Our hypothesis for this research was that the players would choose a direction and then continue to follow that direction throughout the rooms. Even though 16 of our testers took the same way throughout 3 rooms in a row, it was not enough to say that this was a strong pattern. 22 of our testers took the same direction at least 4 times, which could point at a certain choice of keep walking in one direction. Although, since the amount of players doing this were not a majority, this cannot be seen as a strong pattern either.

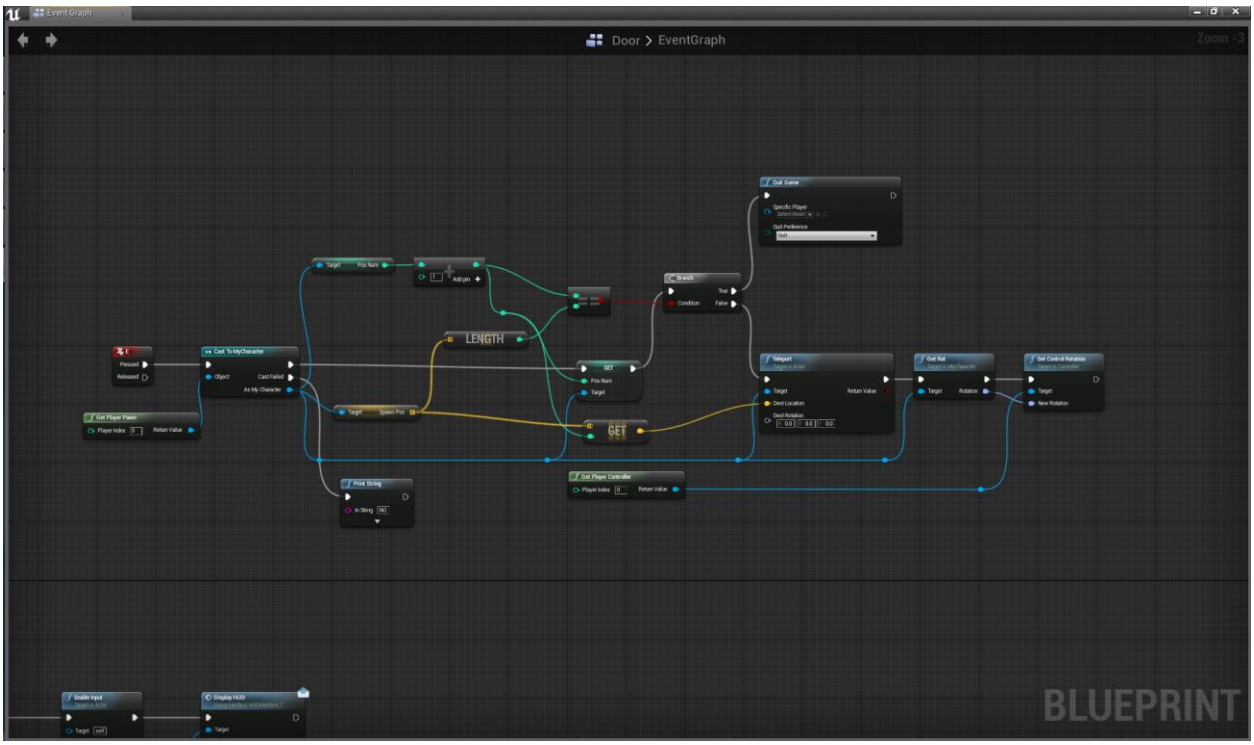
Many testers choose to walk forward, which strengthens the general value principle. If this is correct, then the testers were influenced by the way they were positioned when entering the rooms. Making a new test where the entrances are moved either to the right or left would help this study to further confirm that the general value principle is applicable for the choosing of paths in games, as well as in museums.

References

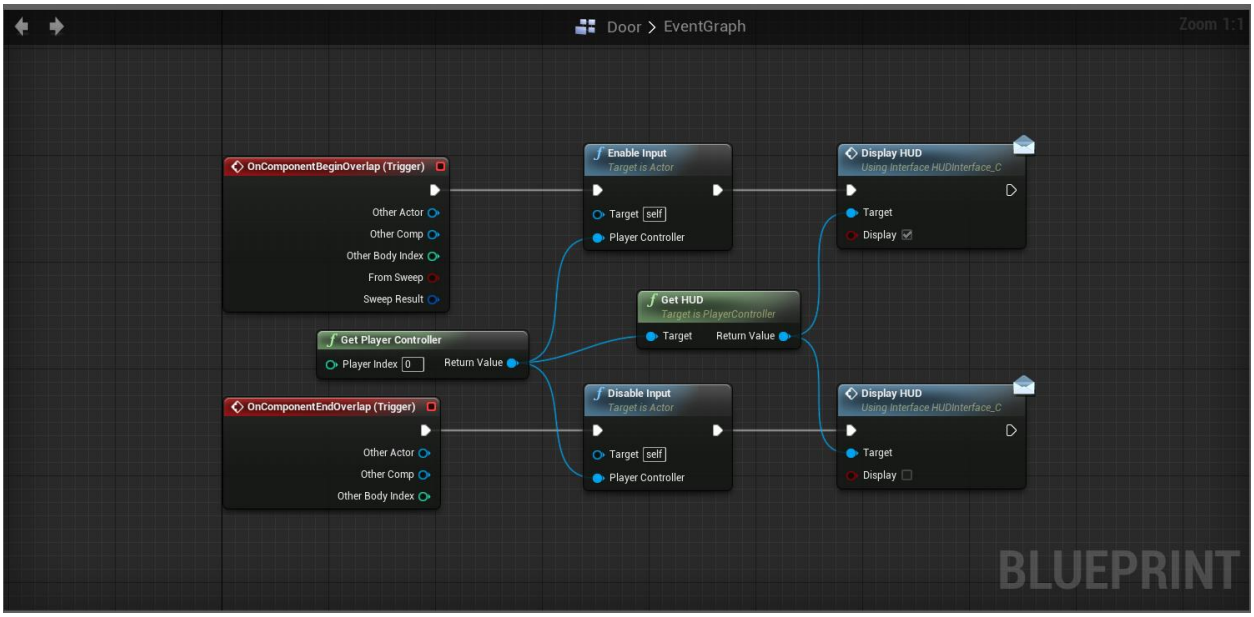
1. Jan L. Soumancorrespondenceemail , Ilja Frissen , Manish N. Sreenivasa , Marc O. Ernst. 2009. *Walking Straight into Circles*. [ONLINE] Available at: http://www.sciencedirect.com/science/article/pii/S0960982209014791. [Accessed 25 March 15].
2. Stephen Bitgood. 2010. *An Analysis of Visitor Circulation: Movement Patterns and the General Value Principle*. [ONLINE] Available at: http://www.jsu.edu/psychology/docs/49.4.Bitgood.pdf. [Accessed 25 March 15].

Appendix

Blueprint A



Blueprint B



Raw data

Room										
										F
1	L	R	R	L	L	F	F	L	R	F
2	F	R	L	F	F	R	R	F	R	F
3	R	R	L	L	L	R	L	L	L	F
4	L	R	F	F	R	R	L	R	L	F
5	F	F	F	L	R	L	R	L	F	F
6	R	L	R	R	L	R	L	L	R	F
7	L	R	F	R	R	R	F	F	L	F
										F
1	F	L	R	F	L	F	L	F	L	F
2	R	F	F	F	R	F	F	R	L	F
3	L	R	L	L	L	R	L	L	L	F
4	R	L	F	L	R	L	R	R	R	F
5	L	F	R	F	L	R	F	R	R	F
6	L	L	L	L	R	R	L	R	L	F
7	R	F	F	L	L	F	L	L	F	F
										F
1	R	R	F	F	L	L	F	F	L	F
2	L	F	L	R	L	L	R	F	L	F
3	L	R	R	L	L	R	R	L	R	F
4	L	F	F	L	F	F	L	L	L	F
5	F	R	F	F	L	F	L	F	R	F
6	R	R	R	L	R	L	L	R	R	F
7	F	L	L	R	R	F	R	F	R	F
										F
1	F	F	L	F	L	L	F	F	F	F
2	R	F	F	F	L	R	L	F	L	F
3	L	L	L	L	L	L	R	L	R	F
4	F	F	F	L	F	R	L	F	F	F
5	L	R	L	F	R	F	L	F	F	F
6	L	R	R	R	R	L	R	L	R	F
7	R	R	R	F	R	F	R	F	R	F
										F
1	F	F	F	F	R	R	F	F	F	F
2	F	R	L	L	R	L	R	F	F	F
3	R	L	L	L	R	L	L	R	R	F
4	L	L	R	F	R	L	L	L	F	F
5	F	R	F	F	R	L	F	F	F	F
6	R	R	R	L	L	R	R	R	R	F
7	L	L	R	F	F	L	L	R	L	F

The numbers indicates which room it is. Each vertical row of letters next to the numbers is the direction choices for each player.